Claims

1. A method of material processing with laser pulses having a large spectral bandwidth, wherein the laser pulses impinge on or enter into an object to be processed and cause a physical or chemical change in the material of the object to be processed, characterized in that one or more spectral parameters of the laser pulses are selectively modified before and/or during the processing process in order to achieve defined processing-specific effects, such as, for example, an increase in processing speed, an improvement in material selectivity, an improvement in surface structuring, or achievement of an optical breakthrough.

2. The method as claimed in Claim 1, characterized in that the modified spectral parameter is the spectral amplitude of the laser pulses.

3. The method as claimed in Claim 1, characterized in that the modified spectral parameter is the spectral phase of the laser pulses.

4. The method as claimed in Claim 1, characterized in that the modified spectral parameter is the spectral polarization of the laser pulses.

5. The method as claimed in Claim 1, characterized in that at least one spectral parameter is preferably dynamically modified as a function of a measurable quantity of the processing process.

6. The method as claimed in Claim 5, characterized in that the removal rate of material processing serves as the measurable quantity.

7. The method as claimed in Claim 5, characterized in that the surface roughness serves as the measurable quantity.

8. The method as claimed in Claim 5, characterized in that the transmission of the object to be processed is used as the measurable quantity, in particular for producing or processing an optical wave guide.

9. The method as claimed in Claim 5, characterized in that the reflection of electromagnetic waves is used as the measurable quantity, in particular for producing or processing an optical wave guide.

10. The method as claimed in Claim 5, characterized in that the fraction of the laser light reflected by the processing zone serves as the measurable quantity.

11. The method as claimed in Claim 5, characterized in that at least one of the resonance frequencies of said component is used as the measurable quantity, in particular for producing or processing a micro-mechanical component.

12. The method as claimed in Claim 5, characterized in that a resonance amplitude at a defined oscillation frequency serves as the measurable quantity, in particular for producing or processing a micro-mechanical component.

13. The method as claimed in Claim 5, characterized in that the hydrohobicity or the hydrophilicity, respectively, of the processing surface is evaluated as the measurable quantity.

14. The method as claimed in Claim 5, characterized in that the anisotropy of the processed material is evaluated as the measurable quantity.

15. The method as claimed in Claim 5, characterized in that, in the processing of composite materials, the material selectivity the interaction with the composite materials is used as the measurable quantity.

16. The method as claimed in Claim 5, characterized in that, in processing micro-electronic components, at least one of their electrical properties, such as conductivity or capacitance, is used as the measurable quantity.

17. The method as claimed in Claim 5, characterized in that, in the treatment of human tissue, in particular human eye tissue, at least one plasma parameter, such as the energy threshold value for the optical breakthrough, the scattered light or the plasma spectrum, is used as the measurable quantity.

18. The method as claimed in Claim 5, characterized in that, in two-photon polymerization of photosensitive materials, in particular of a liquid resin, the quantum efficiency of the polymerization process, optical or mechanical properties of the polymerized material are used as measurable quantities.

19. The method as claimed in Claim 1, characterized in that the spectral parameters of the laser pulses are initially tested for their effect on the intended processing operation and that, subsequently, the spectral parameters selected with regard to the intended processing effect are set as the starting parameters for the material processing process.

20. The method as claimed in Claim 1, characterized in that the spectral parameters of the laser pulses known from experiences or calculations are set as starting parameters for the processing process.

21. An apparatus for carrying out the method as claimed in Claim 1, characterized in that a laser (1) for generating laser pulses having a large spectral bandwidth is connected to a processing unit (3, 11) for laser pulse processing of an object (13) to be processed, wherein the laser (1) is connected to the processing unit (3, 11) via a pulse shaper (2) for setting or modifying, respectively, the amplitude and/or the spectral phase and/or the spectral polarization of the laser pulses.

22. The apparatus as claimed in Claim 21, characterized in that at least one amplification stage (4, 8) for amplification of the laser pulses is arranged preceding or following the pulse shaper (2).

23. The apparatus as claimed in Claim 21, characterized in that a measurement unit (5) for monitoring the processing process is provided, which is connected to the pulse shaper (2) via a control unit (6, 10).

24. The apparatus as claimed in Claim 23, characterized in that the measurement unit (5) comprises at least one measurement unit for measuring the optical material properties, such as scattering, refractive index or plasma emission spectrum.

25. The apparatus as claimed in Claim 23, characterized in that the measurement unit (5) comprises at least one sensor for measurement of the temperature of material processing.

26. The apparatus as claimed in Claim 23, characterized in that the measurement unit (5) comprises at least one sensor for measurement of the surface roughness of the object (13) to be processed.

27. The apparatus as claimed in Claim 23, characterized in that the measurement unit (5) comprises at least one optical sensor.

28. The device as claimed in Claim 21, characterized in that it is suitable for processing human eye tissue.

29. The apparatus as claimed in Claim 21, characterized in that it comprises a spectral phase modulator which is based on the use of a micro-electromechanical system (MEMS).